

【特許請求の範囲】

【請求項1】光電面を内側にもった光入射窓と電子増倍体との間の電子収束空間内に仕切板を配置させ、前記仕切板により前記電子収束空間を複数に分割して複数のセグメントを構成し、前記各セグメント毎に増倍部をもった光電子増倍管において、

前記仕切板の下方に設けられ、前記電子収束空間において、隣接する前記セグメント間を連通させる開口部と、前記電子増倍体に固定させた固定電極板と、

前記仕切板と前記固定電極板との間に架け渡された脚部と、

前記電子増倍体に固定させて、前記固定電極板と前記仕切板との間に配置させた収束電極板と、

前記収束電極板に設けられて、前記脚部を非接触状態で貫通させる脚挿入部とを備えたことを特徴とする光電子増倍管。

【請求項2】前記脚挿入部は、スリット又は穴部であることを特徴とする請求項1記載の光電子増倍管。

【請求項3】前記仕切板の前記開口部内で、前記仕切板の真下に光電面形成用の蒸着源を配置したことを特徴とする請求項1又は2記載の光電子増倍管。

【請求項4】前記仕切板の交差部分には、前記蒸着源のうちのアンチモンビーズを配置したことを特徴とする請求項3記載の光電子増倍管。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、光電子増倍管に係り、特に、複数のセグメントに分割したヘッドオン型の光電子増倍管に関するものである。

【0002】

【従来の技術】従来、このような分野の技術として、特開昭63-91950号公報、特公昭58-41617号公報、特開平7-192686号公報、特公平5-59539号公報又は特開昭63-261664号公報がある。これら公報に記載された光電子増倍管は、光入射窓と電子増倍体との間に仕切板を有し、仕切板によって複数のセグメントに分割している。このようなマルチセグメント形式の光電子増倍管は、各セグメント毎に増倍部を配置させ、X線やガンマ線など放射線源の位置を高精度で割り出すためのものである。

【0003】

【発明が解決しようとする課題】しかしながら、従来の光電子増倍管は、上述したように構成されているため、次のような課題が存在していた。

【0004】すなわち、従来の光電子増倍管は、仕切板により、電子収束空間を各セグメント毎に完全に仕切るように構成され、光電子増倍管の内部で複数のセグメント毎に収束電極部を必要としていた。従って、構造が複雑になると共に、組立て工数も増え、コストアップを招来するといった問題点があった。

【0005】本発明は、上述の課題を解決するためになされたもので、特に、構造が簡単で、部品点数が少なく組立て易い光電子増倍管を提供することを目的とする。

【0006】

【課題を解決するための手段】請求項1に係る本発明の光電子増倍管は、光電面を内側にもった光入射窓と電子増倍体との間の電子収束空間内に仕切板を配置させ、仕切板により電子収束空間を複数に分割して複数のセグメントを構成し、各セグメント毎に増倍部をもった光電子増倍管において、仕切板の下方に設けられ、電子収束空間において、隣接するセグメント間を連通させる開口部と、電子増倍体に固定させた固定電極板と、仕切板と固定電極板との間に架け渡された脚部と、電子増倍体に固定させて、固定電極板と仕切板との間に配置させた収束電極板と、収束電極板に設けられて、脚部を非接触状態で貫通させる脚挿入部とを備えたことを特徴とする。

【0007】この光電子増倍管において、仕切板は、光入射窓に形成した光電面と同電位である必要があり、これに対して、収束電極板は、光電面から放出される電子を各増倍部内に収束させながら入射させるために、光電面の電圧より高い電位を必要とする。その結果、収束電極板上に仕切板を隣接配置させるにあたって、収束電極板と仕切板とを電気的に非接触状態にしておくことが必要である。そこで、収束電極板上の電子収束空間内に仕切板を配置させる場合、仕切板に脚部を設け、収束電極板に設けた脚挿入部内に脚部を非接触状態で挿入することにより、収束電極板と仕切板との非接触状態を確保する。また、電子増倍体に固定した固定電極板に脚部を固定させることにより、仕切板を、電子収束空間内で確実に固定させる。このような構成を採用すると、収束電極板をセグメント毎に個別的に設けることが必要なく、組立て易い光電子増倍管が可能になる。更に、仕切板と収束電極板との間に開口部を積極的に設けることで、光電子増倍管を組み立てる際の光電面形成工程で必要な光電面形成用の蒸着源（例えば、アンチモンビーズやマンガンビーズ等）を、この開口部に配置させることができ、セグメント毎に蒸着源を配置せずとも、必要最小限の蒸着源を電子収束空間内に配置させるだけで、光電面形成用の蒸気に拡散効果に基づいて、光電面を均一に形成することが可能になる。

【0008】請求項2記載の光電子増倍管において、脚挿入部は、スリット又は穴部であると好ましい。このような構成を採用した場合、脚部を介在させた固定電極板と仕切板との非接触状態を簡単かつ確実に達成することができる。

【0009】請求項3記載の光電子増倍管において、仕切板の開口部内で、仕切板の真下に光電面形成用の蒸着源を配置すると好ましい。このような構成を採用した場合、光電面形成用の蒸着源から発生する蒸気が仕切板に邪魔されることなく光電面まで均一に達することにな

り、均質な光電面の形成に寄与する。

【0010】請求項4記載の光電子増倍管において、仕切板の交差部分には、蒸着源のうちのアンチモンビースを配置すると好ましい。このような構成は、均質な光電面を形成する上で極めて好ましい態様である。

【0011】

【発明の実施の形態】以下、図面と共に本発明による光電子増倍管の好適な実施形態について詳細に説明する。

【0012】図1は、本発明に係る光電子増倍管の断面図である。同図に示す光電子増倍管1は、四角柱状をなす中空な透明ガラス製のバルブ2を有し、このバルブ2の一端には、ガラス製の光入射窓3が融着固定され、バルブ2の他端には、ステムピン4を環状に固定したガラス製のシステム5が融着固定されている。そして、バルブ2と光入射窓3とシステム5とで真空容器6を構成している。

【0013】図1及び図2に示すように、真空容器6内には電子増倍体7が配置され、電子増倍体7の上端には収束電極板8が固定され、この収束電極板8と光入射窓3との間には、電子収束空間S(図4参照)が設けられている。この電子収束空間Sは、光入射窓3から放出した電子を収束電極板8の作用によって収束させながら電子増倍体7内に確実に入射させるための空間である。この電子収束空間Sには十文字状の仕切板9が配置され、この仕切板9によって、電子収束空間S内を4つのセグメントに分割している。そして、この仕切板9により、光入射窓3の内側に形成した光電面10を4分割し、それに対応して、電子増倍体7内に4つの増倍部11を設けている。更に、各増倍部11は、配線12を介してシステムピン4に電気的に接続され、それぞれの配線12を各システムピン4から立ち上げて、配線12に電子増倍体7を固定することで、電子増倍体7は、真空容器6内の所定の位置に保持されることになる。

【0014】このような光電子増倍管1の各部品について更に詳述すると、図3に示すように、電子増倍体7は、4枚の側板13で各ダイノードDを挟み付けることで、4つの増倍部11を構成し、各増倍部11で複数段の電子増倍機能を達成させる。また、収束電極板8において、略正方形状の平板をなす収束電極板本体14Aの外周には、一枚の薄板を折曲げ加工又はプレス加工することで作り出される立上げ縁部14が設けられている。更に、収束電極板本体14Aには、各増倍部11に対応して電子入射窓15が4個設けられている。そして、電子増倍体7に対する収束電極板8の組付け固定は、電子増倍体7の側板13の先端に設けた突片16を、収束電極板8に設けた差し込み口17内に挿入させ、突片16の下端に設けた差し込み用切欠き18内にクサビ片19を打ち込むことにより達成させる。

【0015】光入射窓3の内側は、各セグメントに対応させるように光電面10を4分割して、4個の光電面部

分4aを作り出し、各光電面部分4aは四レンズ形状になっている。これに対して、仕切板9は、略同一形状をなす仕切片9Aと仕切板9Bとを直交させるように、スリット部K(図4参照)を介して嵌合させることで、十文字に形成され、4個の光電面部分4aを仕切るように配置される。また、各仕切片9A, 9Bの頂部は、光電面10における各光電面部分4aを仕切る十文字形状の境界線L(図3参照)に対応して湾曲させている。

【0016】また、各仕切片9A, 9Bの両端には、脚部20がそれぞれ一体に形成され、十文字状の仕切板9に4本の脚部20を設けている。そして、各脚部20によって、仕切板9と収束電極板8とを離間させ、そこに開口部Pを形成している(図1参照)。

【0017】また、仕切板9と収束電極板8との電気的な導通は回避させている。具体的に、図3～図5に示すように、収束電極板8には、脚部20を貫通させる脚挿入部としてのスリット21が切り込み形成されている。また、脚部20は、収束電極板8と電気的に非接触状態である必要性から、スリット21は、脚部20に触れない切り込み幅を有している。更に、収束電極板8の下側には、側板13に固定させた固定電極板22が配置され、この固定電極板22に仕切板9の脚部20の先端を固定させている。

【0018】また、固定電極板22は、脚部20を介して仕切板9と電気的に導通させることが必要である。そこで、固定電極板22には、各脚部20の先端を挿入固定させるための脚固定部としての切欠き部23が4個設けられている。そして、各切欠き部23に脚部20の先端をそれぞれ挿入させ、脚部20の先端部20aをL字状に折り曲げた後、この先端部20aと固定電極板22とをスポット溶接することで、固定電極板22に対する仕切板9の固定が達成される。

【0019】また、固定電極板22は、U字状をなす第1の固定電極板22aと直線状をなす第2の固定電極板22bとで二分割の構成をなす。そこで、電子増倍体7の側板13に設けられた各差し込み用切欠き24内に第1の固定電極板22a及び第2の固定電極板22bをそれぞれ外側から差し込み、第1の固定電極板22aと第2の固定電極板22bとの接合部分をスポット溶接することにより、電子増倍体7に対する固定電極板22の固定を達成する。

【0020】なお、この固定電極板22の周縁には、バルブ2の内壁面に当接させる爪状のスプリング片25がスポット溶接により固定されている。また、電子増倍体7の下端は、シールド板26により覆っている。そして、バルブ2の上部の内壁面には、光電面10と接触しているアルミ薄膜Aが設けられている。従って、スプリング片25をアルミ薄膜Aと接触させることで、光電面10と仕切板9とを同電位にする。

【0021】このように、光電子増倍管1は、光入射窓

3と電子増倍体7との間の電子収束空間Sに十文字の仕切板9を有し、仕切板9及び4個の増倍部11によつて、光電子増倍管1の内部を四つのセグメントに分割されている。このような光電子増倍管1は、4セグメント型の光電子増倍管と称され、各セグメント毎に電子を増倍させることを可能にし、X線やガンマ線などの放射線源の位置の割り出し精度の向上を図っている。また、収束電極板8はセグメント毎に個別的に設けられておらず、組立て易い光電子増倍管1をも可能にする。更に、仕切板8と収束電極板8との間に開口部Pを積極的に設けることで、光電子増倍管1を組み立てる際に光電面形成工程で必要となる光電面形成用の蒸着源（例えば、アンチモンビーズやマンガンビーズ等）28を、この開口部Pに配置させることができる。

【0022】具体的に、図5及び図6に示すように、仕切片9Bの真下に光電面形成用の蒸着源28を配置させ、この蒸着源28は、アンチモンビーズ28aとマンガンビーズ28bとからなる。これらビーズ28a、28bは、収束電極板8に固定させたハーメチックシール30から伸びるリード線31に固定され、開口部P内に配置させている。ここで、アンチモンビーズ28aは、収束板9の交差部分すなわち仕切片9Aと9Bとが交差する位置の真下に配置され、このアンチモンビーズ28aの両側にはマンガンビーズ28bを配置させている。

【0023】このように、電子収束空間Sに開口部Pを積極的に設けることで、セグメント毎に蒸着源28を配置せずとも、必要最小限のビーズ28a、28bを電子収束空間S内に配置させるだけでよい。そして、リード線31に電流を流し、ビーズ28a、28bを加熱させることで、ビーズ蒸気が発生し、この蒸気の拡散に基づいて、光電面10の均一な形成を可能にする。また、仕切片9Aと9Bとが交差する位置の真下に、アンチモンビーズ28aを配置させることは、均質な光電面10を形成する上で極めて好ましい。

【0024】ここで、本発明の光電子増倍管1の他の実施形態として、図7に示すように、第1の仕切片33Aと第2の仕切片33Bとからなる仕切板33には棒状の脚部34が溶接固定されている。また、収束電極板8において、収束電極板本体14Aには、各脚部34を非接触状態で挿入させる脚挿入部としての穴部35が形成されている。そして、固定電極板22には、各脚部34の先端を挿入固定させるための脚固定部としての穴部36が4個形成されている。そこで、各穴部36に脚部34の先端をそれぞれ挿入させ、脚部34の先端部34aをL字状に折り曲げた後、この先端部34aと固定電極板22とを溶接することで、固定電極板22に対する仕切板33の固定を達成させている。なお、図7において、図3と同一又は同等な構成部分には同一の符号を付し、その説明は省略する。

【0025】本発明は、前述した実施形態に限定される

ものではなく、例えば、図8に示すように3セグメント型の光電子増倍管40の場合、仕切板41は、交差することのない平行な2枚の仕切片41A、41Bにより構成される。そして、各仕切片41A、41Bの真下にアンチモンビーズ28a及びマンガンビーズ28bをそれぞれ配置させる。

【0026】また、図9に示すように8セグメント型の光電子増倍管50の場合、仕切板51は、横に伸びた平行な3枚の仕切片51A、51B、51Cと、これらに交差するように縦に伸びた1枚の仕切片51Dとにより構成される。そして、仕切片51Dの真下に蒸着源28を配置させる。この場合、アンチモンビーズ28aとマンガンビーズ28bは、仕切板51の中心位置Oを基準とした対称関係になるようにそれぞれバランス良く配置されている。すなわち、中心位置Oは、光電面10の中心でもあるから、この位置Oを中心として、対称となる位置にアンチモンビーズ28aとマンガンビーズ28bとをバランス良く配置させることで、電子収束空間S内でビーズ蒸気を均一に拡散させることができる。

【0027】なお、セグメント数に拘わらず、蒸着源28を、光電面10の中心位置Oを基準としてバランスよく配置させることが、光電面10を形成する上で肝要であり、蒸着源28は、必ずしも仕切板の真下にある必要はない。また、セグメント毎に蒸着源を設けてもよい。

【0028】

【発明の効果】本発明による光電子増倍管は、以上のように構成されているため、次のような効果を得る。すなわち、仕切板の下方に設けられ、電子収束空間において、隣接するセグメント間を連通させる開口部と、電子増倍体に固定させた固定電極板と、仕切板と固定電極板との間に架け渡された脚部と、電子増倍体に固定させて、固定電極板と仕切板との間に配置させた収束電極板と、収束電極板に設けられて、脚部を非接触状態で貫通させる脚挿入部とを備えたことにより、構造が簡単で、部品点数が少なく組立て易い光電子増倍管を可能にする。

【図面の簡単な説明】

【図1】本発明に係る光電子増倍管の一実施形態を示す縦断面図である。

【図2】図1に示した光電子増倍管の内部を示す斜視図である。

【図3】本発明に係る光電子増倍管の分解斜視図である。

【図4】図1に示した光電子増倍管の要部を示す拡大断面図である。

【図5】図1に示した光電子増倍管の要部を示す斜視図である。

【図6】本発明に係る光電子増倍管の横断面図である。

【図7】本発明に係る光電子増倍管の第2の実施形態を示すの要部分解斜視図である。

【図8】本発明に係る光電子増倍管の第3の実施形態を示す横断面図である。

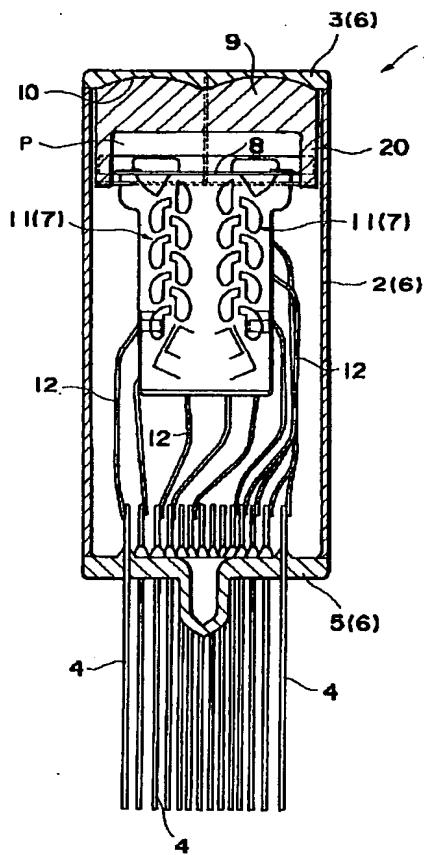
【図9】本発明に係る光電子増倍管の第4の実施形態を示す横断面図である。

【符号の説明】

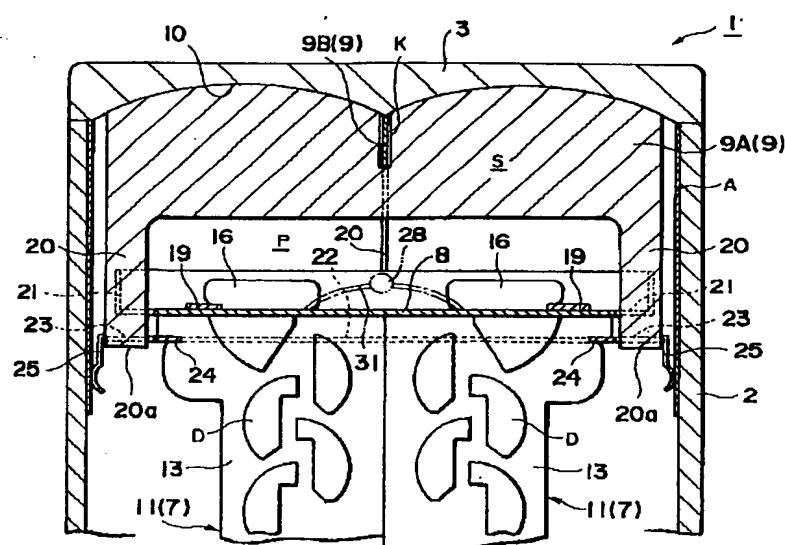
S…電子収束空間、P…開口部、1, 40, 50…光電

子増倍管、3…光入射窓、7…電子増倍体、8…収束電極板、9、41、51…仕切板、10…光電面、11…増倍部、20、34…脚部、21…スリット（脚挿入部）、22…固定電極板、28…蒸着源、28a…アンチモンビース、35…穴部（脚挿入部）。

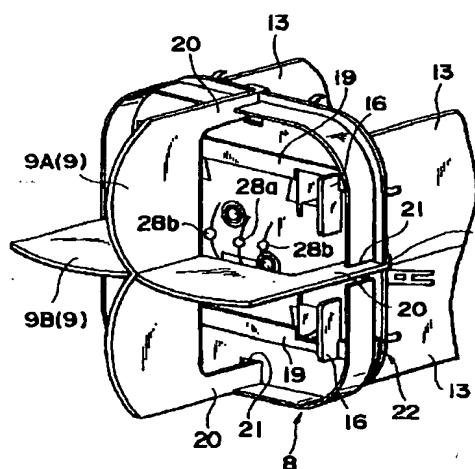
【図 1】



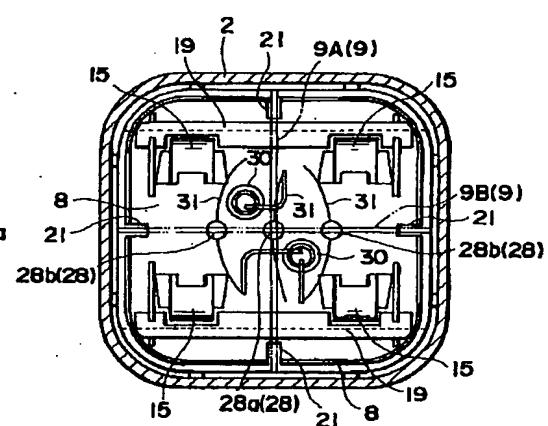
【図4】



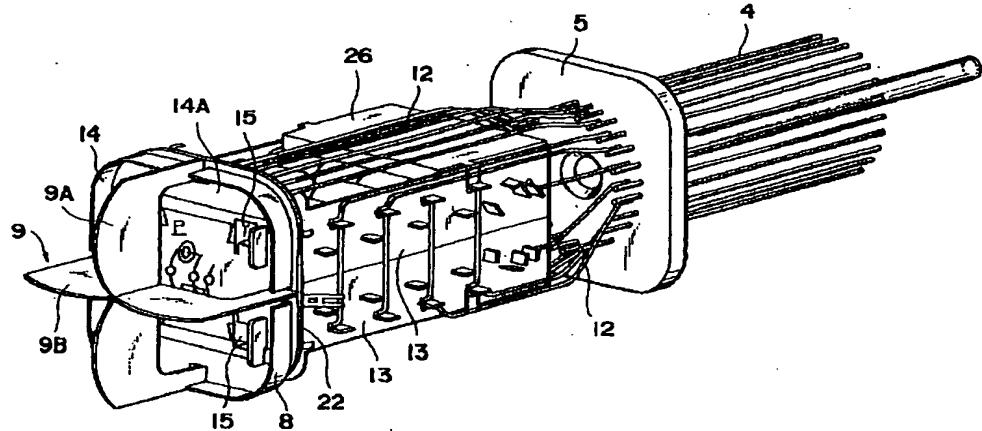
【図5】



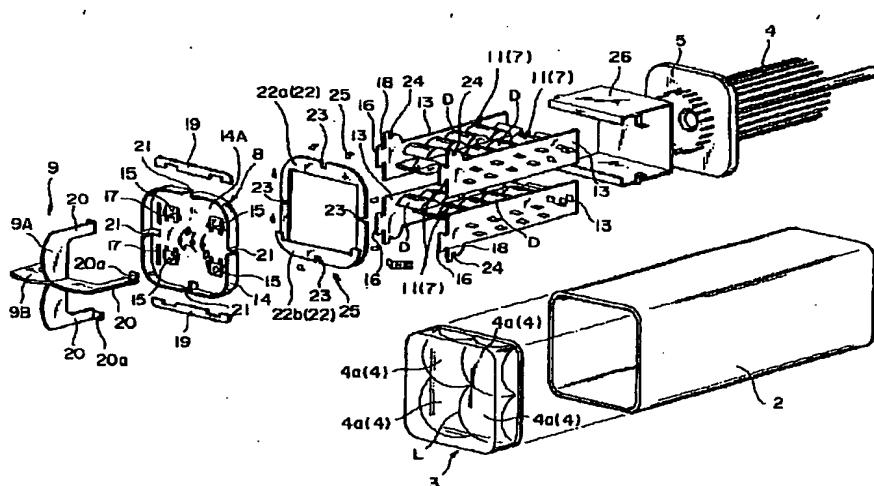
[图 6]



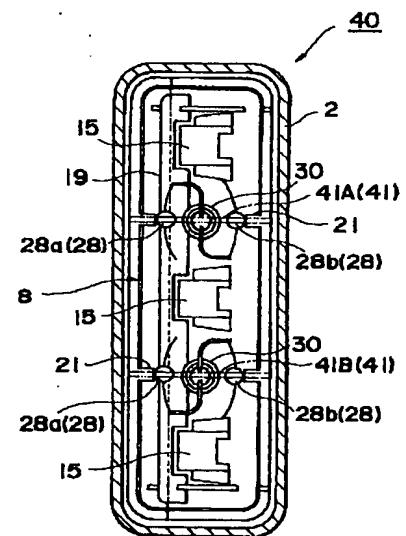
【図2】



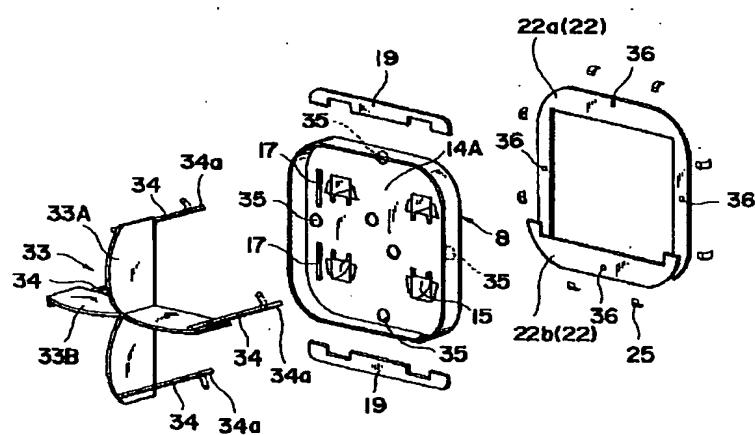
【図3】



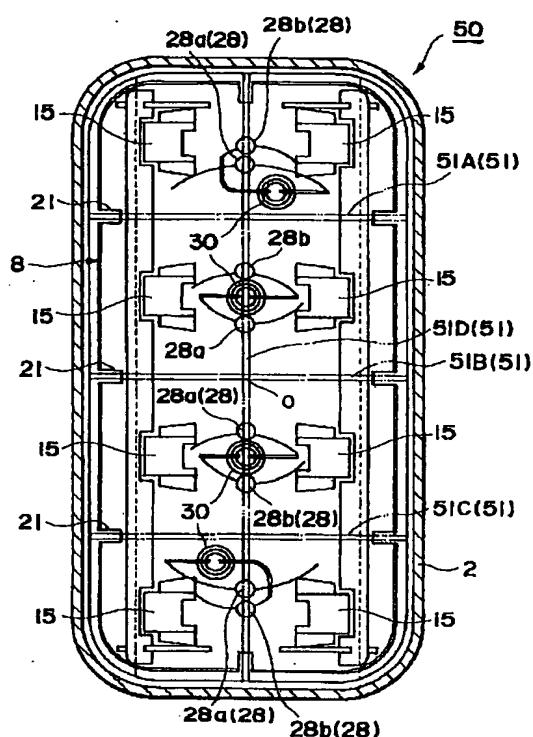
【図8】



【図7】



【図9】



PATENT ABSTRACTS OF JAPAN

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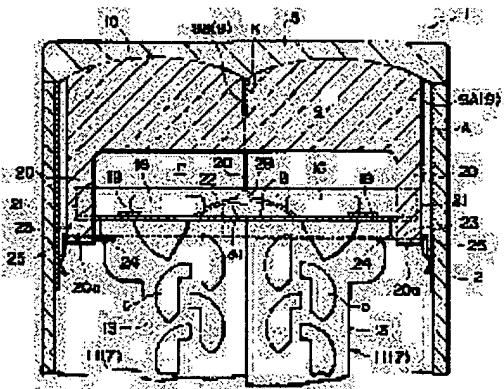
(21)Application number : 10-049471 (71)Applicant : HAMAMATSU PHOTONICS KK
(22)Date of filing : 02.03.1998 (72)Inventor : KIMURA SUENORI
MACHIDA KATSUHIKO
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(54) PHOTOMULTIPLIER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a photomultiplier of simple structure which is of a simple structure, which comprises a less number of part items, and which can be easily assembled.

SOLUTION: In a photomultiplier 1, a partition plate 9 is disposed to be adjacent to a convergence electrode plate 8 on it, where the convergence electrode plate 8 need be in an electrically contactless condition to the partition plate 9. In disposing the partition plate 9 in an electron convergence space S on the convergence electrode plate 8, therefore, a leg part 20 is provided on the partition plate 9, and the leg part 20 is inserted into a leg insertion part 21 provided in the convergence electrode plate 8 in a contactless condition, so the contactless condition between the convergence electrode plate 8 and the partition plate 9 is secured. The leg part 20 is fixed to a fixed electrode plate 22 fixed on a photomultiplying body 7, so the partition plate 9 is surely fixed in the electron convergence space S. By positively providing an opening part P between the partition plate 9 and the convergence electrode plate 8, an antimony bead 28 or the like necessary in a photoelectric surface forming process in assembling the photomultiplier 1 can be disposed in the opening part P.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

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CLAIMS**[Claim(s)]**

[Claim 1] A dashboard is arranged in the electronic convergence space between the optical entrance windows and electronic multiplication objects which had the photoelectric surface inside. In the photomultiplier tube which divided said electronic convergence space into plurality with said dashboard, constituted two or more segments, and had the multiplication section for said every segment Opening which said dashboard is formed [opening] caudad and makes between said adjoining segments open for free passage in said electronic convergence space, The leg over which it was built between the fixed electrode plate made to fix to said electronic multiplication object, and said dashboard and said fixed electrode plate, The photomultiplier tube characterized by having made it fix to said electronic multiplication object, having been prepared in the convergence electrode plate arranged between said fixed electrode plates and said dashboards, and said convergence electrode plate, and having the foot insertion section which makes said leg penetrate in the state of non-contact.

[Claim 2] Said foot insertion section is the photomultiplier tube according to claim 1 characterized by being a slit or a hole.

[Claim 3] The photomultiplier tube according to claim 1 or 2 characterized by having arranged the source of vacuum evaporationo for photoelectric-surface formation to just under said dashboard in said opening department of said dashboard.

[Claim 4] The photomultiplier tube according to claim 3 characterized by having arranged antimony BISU of said sources of vacuum evaporationo at a part for the intersection of said dashboard.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the photomultiplier tube and relates to the photomultiplier tube of the head ON mold especially divided into two or more segments.

[0002]

[Description of the Prior Art] Conventionally, there is JP,63-91950,A, JP,58-41617,B, JP,7-192686,A, JP,5-59539,B, or JP,63-261664,A as a technique of such a field. The photomultiplier tube indicated by these official reports has a dashboard between an optical entrance window and an electronic multiplication object, and is dividing it into two or more segments with the dashboard. The photomultiplier tube of such a multi-segment format is for arranging the multiplication section for every segment and deducing the location of the radiation sources, such as an X-ray and a gamma ray, with high degree of accuracy.

[0003]

[Problem(s) to be Solved by the Invention] However, since the conventional photomultiplier tube was constituted as mentioned above, the following technical problems existed.

[0004] Namely, with the dashboard, the conventional photomultiplier tube was constituted so that electronic convergence space might be completely divided for every segment, and it needed the convergence polar zone for two or more segments of every inside the photomultiplier tube. Therefore, while structure became complicated, the assembly man day also increased and there was a trouble of inviting a cost rise.

[0005] This invention was made in order to solve an above-mentioned technical problem, especially, is easy structure and aims at offering the photomultiplier tube which components mark tend to assemble few.

[0006]

[Means for Solving the Problem] The photomultiplier tube of this invention concerning claim 1 arranges a dashboard in the electronic convergence space between the optical entrance windows and electronic multiplication objects which had the photoelectric surface inside. In the photomultiplier tube which divided electronic convergence space into plurality with the dashboard, constituted two or more segments, and had the multiplication section for every segment Opening which a dashboard is formed [opening] caudad and makes between the adjoining segments open for free passage in electronic convergence space, The leg over which it was built between the fixed electrode plate made to fix to an electronic multiplication object, and a dashboard and a fixed electrode plate, It is characterized by having made it fix to an electronic multiplication object, having been prepared in the convergence electrode plate arranged between the fixed electrode plate and the dashboard, and the convergence electrode plate, and having the foot insertion section which makes the leg penetrate in the state of non-contact.

[0007] In this photomultiplier tube, a dashboard needs to be the photoelectric surface and this potential which were formed in the optical entrance window, on the other hand in order to carry out incidence of the convergence electrode plate, completing the electron emitted from the photoelectric surface as each multiplication circles, it needs potential higher than the electrical potential difference of the photoelectric surface. Consequently, in carrying out contiguity arrangement of the dashboard on a convergence electrode plate, it is required to change a convergence electrode plate and a dashboard into a non-contact condition electrically. Then, when arranging a dashboard in the electronic convergence space on a convergence electrode plate, the non-contact condition of a convergence electrode plate and a dashboard is secured by inserting the leg in the foot insertion circles which prepared the leg in the dashboard and were prepared in the convergence electrode plate in the state of non-contact. Moreover, a dashboard is made to certainly fix in electronic convergence space by making the leg fix to the fixed electrode plate fixed to the electronic multiplication object. If such a configuration is adopted, it will be unnecessary to form a convergence electrode plate individually for

every segment, and the photomultiplier tube which is easy to assemble will become possible. By furthermore, the thing positively established for opening between a dashboard and a convergence electrode plate The source of vacuum evaporationo required of the photoelectric-surface formation process at the time of assembling the photomultiplier tube for photoelectric-surface formation Only by (for example, being able to arrange an antimony bead, a manganese bead, etc.) to this opening, and not arranging the source of vacuum evaporationo for every segment, but ** arranging the necessary minimum source of vacuum evaporationo in electronic convergence space It becomes possible to form the photoelectric surface in the steam for photoelectric-surface formation at homogeneity based on a spreading effect.

[0008] In the photomultiplier tube according to claim 2, the foot insertion section is desirable in their being a slit or a hole. When such a configuration is adopted, the non-contact condition of the fixed electrode plate and dashboard between which the leg was made to be placed can be attained simply and certainly.

[0009] In the photomultiplier tube according to claim 3, in the opening department of a dashboard, when the source of vacuum evaporationo for photoelectric-surface formation to just under a dashboard is arranged, it is desirable. When such a configuration is adopted, homogeneity will be reached to the photoelectric surface, without being interfered with the steam generated from the source of vacuum evaporationo for photoelectric-surface formation by the dashboard, and it contributes to formation of the homogeneous photoelectric surface.

[0010] In a photo-multiplier according to claim 4, when antimony BISU of the sources of vacuum evaporationo is arranged to a part for the intersection of a dashboard, to it, it is desirable. Such a configuration is a mode very desirable when forming the homogeneous photoelectric surface.

[0011]

[Embodiment of the Invention] Hereafter, the suitable operation gestalt of the photomultiplier tube by this invention is explained to a detail with a drawing.

[0012] Drawing 1 is the sectional view of the photomultiplier tube concerning this invention. The photo-multiplier 1 shown in this drawing has the transparency glass hollow bulb 2 which makes the shape of the square pole, welding immobilization of the glass optical entrance window 3 is carried out, and welding immobilization of the glass stem 5 which fixed the stem pin 4 to the other end of a bulb 2 annularly is carried out at the end of this bulb 2. And the vacuum housing 6 consists of a bulb 2, an optical entrance window 3, and a stem 5.

[0013] As shown in drawing 1 and drawing 2 , the electronic multiplication object 7 is arranged in a vacuum housing 6, the convergence electrode plate 8 is fixed to the upper limit of the electronic multiplication object 7, and the electronic convergence space S (refer to drawing 4) is formed between this convergence electrode plate 8 and the optical entrance window 3. This electronic convergence space S is the space for carrying out incidence certainly into the electronic multiplication object 7, completing the electron emitted from the optical entrance window 3 according to an operation of the convergence electrode plate 8. The cross-like dashboard 9 is arranged in this electronic convergence space S, and this dashboard 9 is dividing the inside of the electronic convergence space S into four segments. And with this dashboard 9, the photoelectric surface 10 formed inside the optical entrance window 3 was quadrisected, and the four multiplication sections 11 are formed in the electronic multiplication object 7 corresponding to it. Furthermore, it connects with a stem pin 4 electrically through wiring 12, and each multiplication section 11 starts each wiring 12 from each stem pin 4, it is making the electronic multiplication object 7 fix to wiring 12, and the electronic multiplication object 7 will be held at the position within a vacuum housing 6.

[0014] When each part article of such the photomultiplier tube 1 is explained further in full detail, the electronic multiplication object 7 is inserting each dynode D with the side plate 13 of four sheets, constitutes the four multiplication sections 11, and makes two or more steps of electronic multiplication functions attain in each multiplication section 11, as shown in drawing 3 . Moreover, in the convergence electrode plate 8, the starting edge 14 which bends the sheet metal of one sheet and is made by processing or carrying out press working of sheet metal is established in the periphery of body of convergence electrode plate 14A which makes an abbreviation square-like plate. Furthermore, corresponding to each multiplication section 11, four electronic entrance windows 15 are formed in body of convergence electrode plate 14A. And attachment immobilization of the convergence electrode plate 8 to the electronic multiplication object 7 makes the protruding piece 16 prepared at the tip of the side plate 13 of the electronic multiplication object 7 insert into the opening 17 formed in the convergence electrode plate 8, and is made to attain by driving in the piece 19 of a wedge in the notch 18 for plugs prepared in the lower limit of a protruding piece 16.

[0015] The inside of the optical entrance window 3 quadrisects the photoelectric surface 10 so that each segment may be made to correspond, four photoelectric-surfaces partial 4a is made, and each photoelectric-surface partial 4a has become a concave lens configuration. On the other hand, by carrying out fitting through the slit section K (referring to drawing 4), a dashboard 9 is formed in a cross, and it is arranged so that four photoelectric-surfaces partial 4a may be divided, so that piece of batch 9A and dashboard 9B which make an abbreviation same configuration may be made to intersect

perpendicularly. Moreover, the crowning of each pieces 9A and 9B of a batch is incurvated corresponding to the boundary line L of the cross configuration which divides each photoelectric-surface partial 4a in the photoelectric surface 10 (refer to drawing 3).

[0016] Moreover, the leg 20 was formed in one, respectively and the four legs 20 are formed in the both ends of each pieces 9A and 9B of a batch at the cross-like dashboard 9. And by each leg 20, a dashboard 9 and the convergence electrode plate 8 are made to estrange, and Opening P is formed there (refer to drawing 1).

[0017] Moreover, the electric flow with a dashboard 9 and the convergence electrode plate 8 is made to avoid. Concretely, as shown in drawing 3 - drawing 5 , the slit 21 as the foot insertion section which makes the leg 20 penetrate is cut deeply and formed in the convergence electrode plate 8. Moreover, the slit 21 has the slitting width of face which cannot touch the leg 20 from the need that the leg 20 is in a non-contact condition as electrically as the convergence electrode plate 8. Furthermore, the fixed electrode plate 22 which the side plate 13 was made to fix to the convergence electrode plate 8 bottom is arranged, and the tip of the leg 20 of a dashboard 9 is made to fix to this fixed electrode plate 22.

[0018] Moreover, the fixed electrode plate 22 needs making it flow electrically with a dashboard 9 through the leg 20. So, four notches 23 as a foot fixed part for carrying out insertion immobilization of the tip of each leg 20 are formed in the fixed electrode plate 22. And after making the tip of the leg 20 insert in each notch 23, respectively and bending point 20a of the leg 20 in the shape of L character, immobilization of the dashboard 9 to the fixed electrode plate 22 is attained by carrying out spot welding of this point 20a and the fixed electrode plate 22.

[0019] Moreover, the fixed electrode plate 22 constitutes two piece housing from the 1st fixed electrode plate 22a which makes the shape of U character, and the 2nd fixed electrode plate 22b which makes the shape of a straight line. Then, immobilization of the fixed electrode plate 22 to the electronic multiplication object 7 is attained by inserting 1st fixed electrode plate 22a and 2nd fixed electrode plate 22b from an outside, respectively in each notch 24 for plugs prepared in the side plate 13 of the electronic multiplication object 7, and carrying out spot welding of the part for the joint of 1st fixed electrode plate 22a and 2nd fixed electrode plate 22b.

[0020] In addition, the piece 25 of a spring of the shape of a pawl made to contact the internal surface of a bulb 2 is being fixed to the periphery of this fixed electrode plate 22 by spot welding. Moreover, the lower limit of the electronic multiplication object 7 is covered with the shielding plate 26. And the aluminum thin film A in contact with the photoelectric surface 10 is formed in the internal surface of the upper part of a bulb 2. Therefore, the photoelectric surface 10 and a dashboard 9 are made into this potential by contacting the piece 25 of a spring to the aluminum thin film A.

[0021] Thus, the photomultiplier tube 1 has the dashboard 9 of a cross to the electronic convergence space S between the optical entrance window 3 and the electronic multiplication object 7, and a dashboard 9 and the four multiplication sections 11 divide the interior of the photomultiplier tube 1 into four segments. Such the photomultiplier tube 1 is called the photomultiplier tube of 4 segmental dies, makes it possible to carry out multiplication of the electron for every segment, and is aiming at improvement in the indexing precision of the location of the radiation sources, such as an X-ray and a gamma ray. Moreover, the convergence electrode plate 8 is not individually formed for every segment, but also makes possible the photomultiplier tube 1 which is easy to assemble. Furthermore, by forming Opening P positively between a dashboard 8 and the convergence electrode plate 8, in case the photomultiplier tube 1 is assembled, the sources 28 of vacuum evaporationo for photoelectric-surface formation (for example, an antimony bead, a manganese bead, etc.) which are needed with a photoelectric-surface formation process can be arranged to this opening P.

[0022] Concretely, as shown in drawing 5 and drawing 6 , the source 28 of vacuum evaporationo for photoelectric-surface formation to just under piece of batch 9B is arranged, and this source 28 of vacuum evaporationo consists of antimony bead 28a and manganese bead 28b. It is fixed to the lead wire 31 prolonged from the hermetic sealing 30 made to fix to the convergence electrode plate 8, and these BISU 28a and 28b is arranged in Opening P. Here, antimony BISU 28a is arranged just under the location where it crosses, parts for Intersection 9A and 9B, i.e., the pieces of a batch, of the convergence plate 9, and is arranging manganese BISU 28b on both sides of this antimony BISU 28a.

[0023] thus, by forming Opening P in the electronic convergence space S positively, the source 28 of vacuum evaporationo is not arranged for every segment, but ** also arranges the necessary minimum beads 28a and 28b in the electronic convergence space S -- being sufficient . And a bead steam generates a current by making a sink and Beads 28a and 28b heat in lead wire 31, and uniform formation of the photoelectric surface 10 is enabled based on diffusion of this steam. Moreover, it is very desirable to arrange antimony BISU 28a just under the location where the pieces 9A and 9B of a batch cross, when forming the homogeneous photoelectric surface 10.

[0024] Here, as other operation gestalten of the photomultiplier tube 1 of this invention, as shown in drawing 7 ,

welding immobilization of the rod-like leg 34 is carried out at the dashboard 33 which consists of the 1st piece of batch 33A, and the 2nd piece of batch 33B. Moreover, in the convergence electrode plate 8, the hole 35 as the foot insertion section in which each leg 34 is made to insert in the state of non-contact is formed in body of convergence electrode plate 14A. And four holes 36 as a foot fixed part for carrying out insertion immobilization of the tip of each leg 34 are formed in the fixed electrode plate 22. Then, after making the tip of the leg 34 insert in each hole 36, respectively and bending point 34a of the leg 34 in the shape of L character, immobilization of the dashboard 33 to the fixed electrode plate 22 is made to attain by welding this point 34a and the fixed electrode plate 22. In addition, in drawing 7, the same sign is given to a component the same as that of drawing 3, or equivalent, and the explanation is omitted.

[0025] This invention is not limited to the operation gestalt mentioned above, and in the case of the photomultiplier tube 40 of 3 segmental dies, a dashboard 41 is constituted by the parallel pieces 41A and 41B of a batch of two sheets not crossing as shown in drawing 8. And just under each pieces 41A and 41B of a batch, antimony BISU28a and manganese BISU 28b are arranged, respectively.

[0026] Moreover, in the case of the photomultiplier tube 50 of 8 segmental dies, a dashboard 51 is constituted by the pieces 51A, 51B, and 51c of a batch of three parallel sheets prolonged horizontally, and piece of batch 51D of one sheet perpendicularly prolonged so that these might be intersected as shown in drawing 9. And the source 28 of vacuum evaporationo is arranged just under piece of batch 51D. In this case, antimony BISU 28a and manganese BISU 28b are arranged with respectively sufficient balance so that it may become the symmetric relation on the basis of the center position O of a dashboard 51. That is, since a center position O is also the core of the photoelectric surface 10, it can make homogeneity diffuse a BISU steam in the electronic convergence space S by arranging antimony BISU 28a and manganese BISU 28b with sufficient balance in the location which becomes symmetrical centering on this location O.

[0027] In addition, irrespective of the number of segments, it is important to arrange the source 28 of vacuum evaporationo with sufficient balance on the basis of the center position O of the photoelectric surface 10, when forming the photoelectric surface 10, and the source 28 of vacuum evaporationo does not necessarily need to be just under a dashboard. Moreover, the source of vacuum evaporationo may be prepared for every segment.

[0028]

[Effect of the Invention] Since the photomultiplier tube by this invention is constituted as mentioned above, it acquires the following effectiveness. Namely, opening which a dashboard is formed [opening] caudad and makes between the adjoining segments open for free passage in electronic convergence space, The leg over which it was built between the fixed electrode plate made to fix to an electronic multiplication object, and a dashboard and a fixed electrode plate, By having made it fix to an electronic multiplication object, having been prepared in the convergence electrode plate arranged between the fixed electrode plate and the dashboard, and the convergence electrode plate, and having had the foot insertion section which makes the leg penetrate in the state of non-contact, structure is easy and the photomultiplier tube which components mark tend to assemble few is made possible.

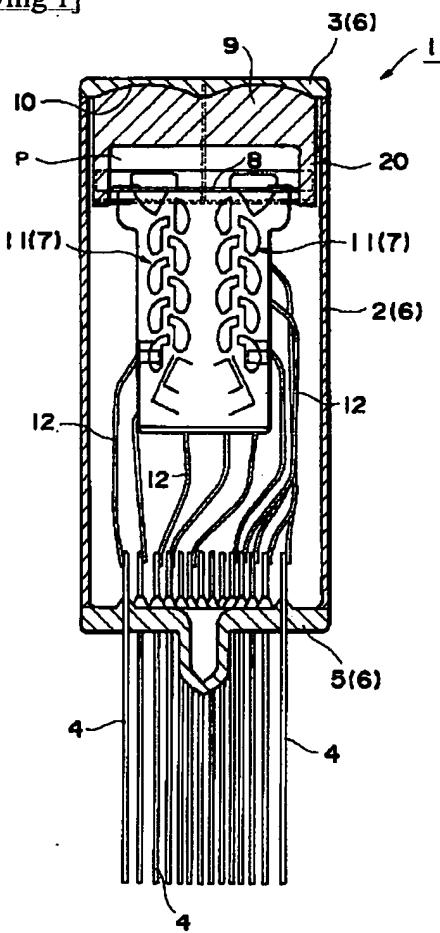
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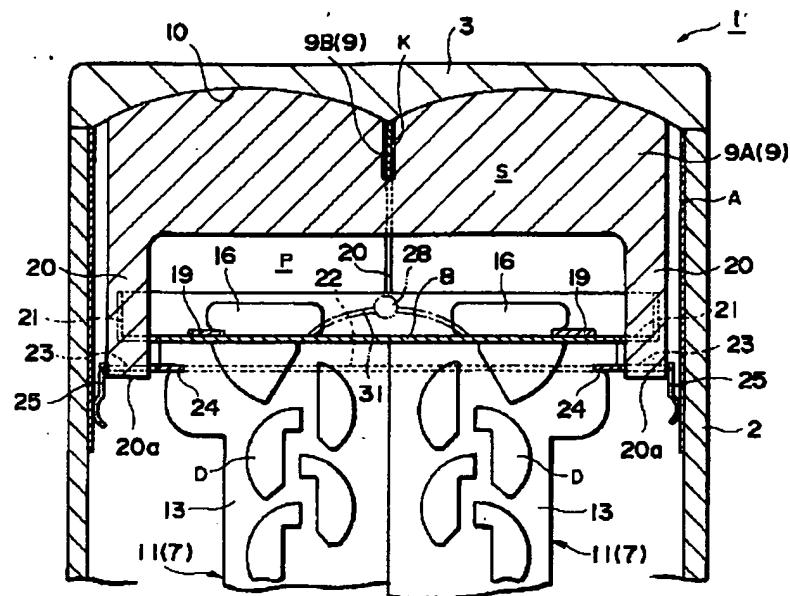
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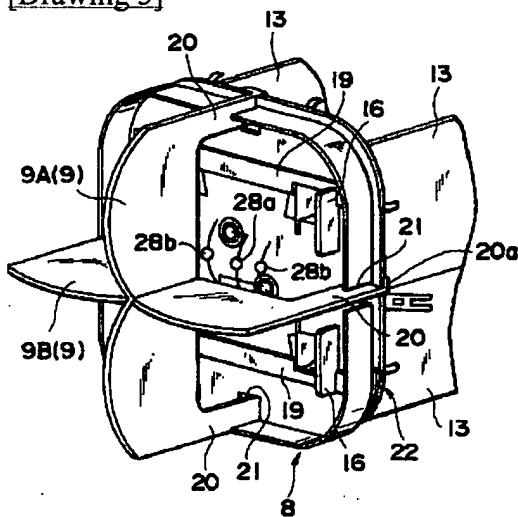
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DRAWINGS

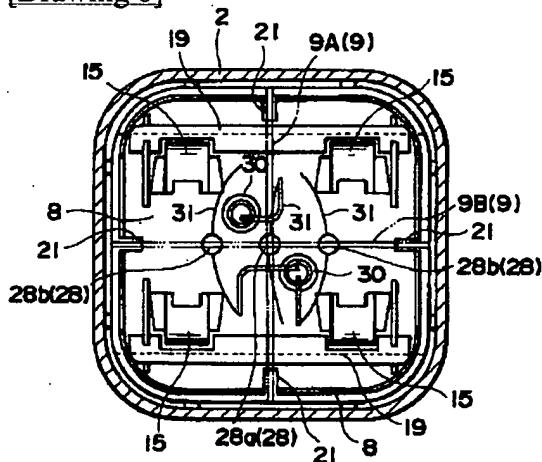
[Drawing 1]**[Drawing 4]**



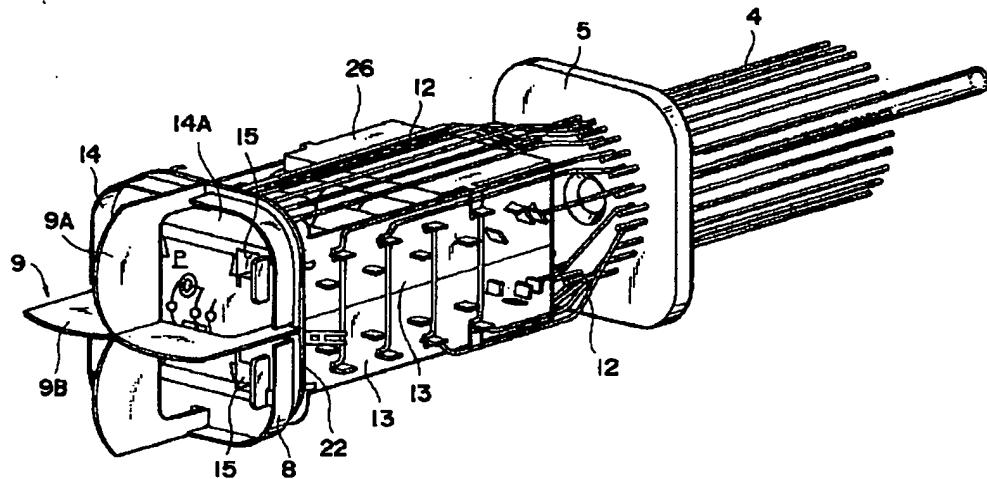
[Drawing 5]



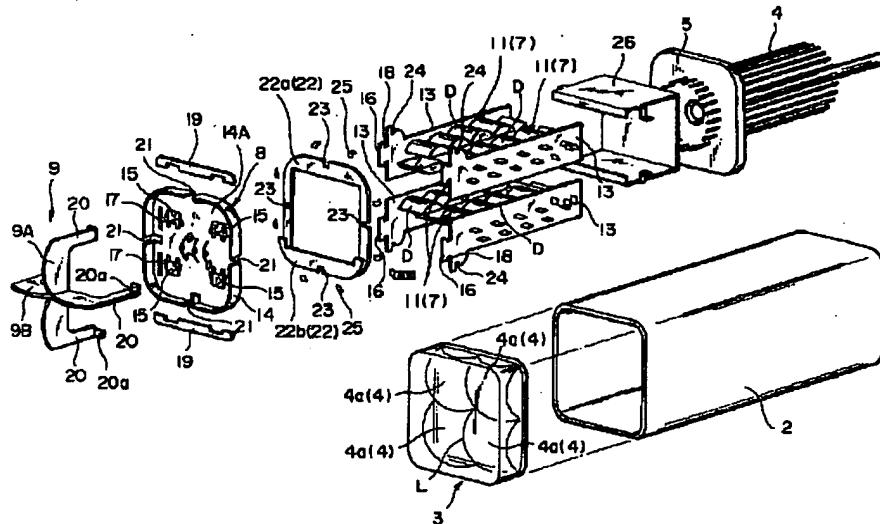
[Drawing 6]



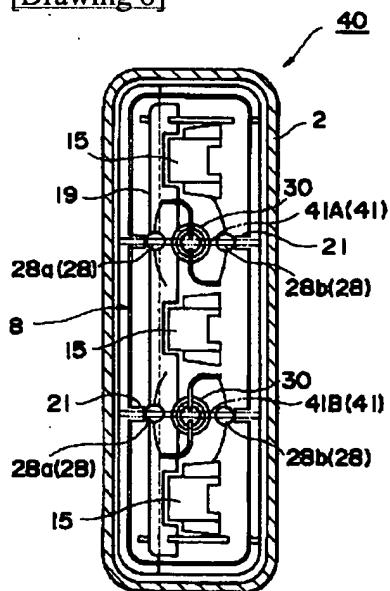
[Drawing 2]



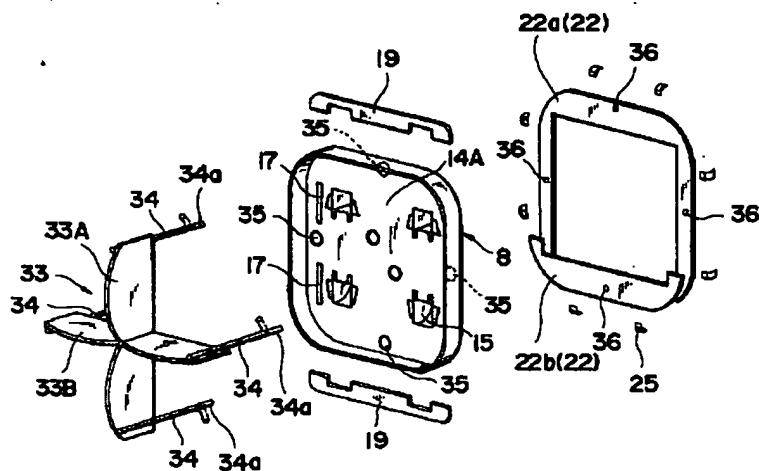
[Drawing 3]



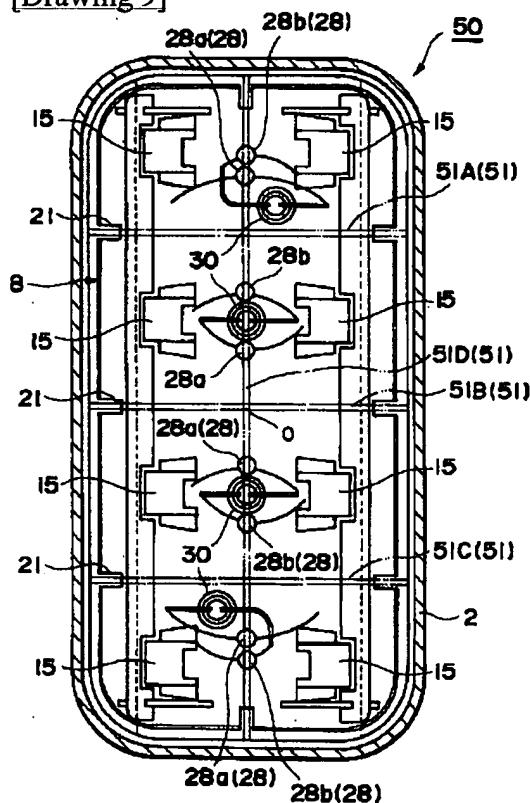
[Drawing 8]



[Drawing 7]



[Drawing 9]



[Translation done.]